Candidate style answers

Critical maths

High banded responses

Introduction

This resource has been produced by a senior member of the Core Maths examining team to offer teachers an insight into how the assessment objectives are applied. It has taken questions from the sample question paper and used them to illustrate how the questions might be answered and provide some commentary on what factors contribute to overall levels.

As these responses have not been through full moderation, they are banded to give an indication of the level of each response. Please note that this resource is provided for advice and guidance only and does not in any way constitute an indication of grade boundaries or endorsed answers.

The sample assessment material for these answers and commentary can be found on Teach Cambridge.

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Question 2

Dev books a holiday which costs £5000.

He pays with his credit card which charges an annual interest rate (APR) of 16%.
Dev wants to pay back the money over **two** years.
He estimates that his monthly repayments will be £208 to the **nearest pound**.

(a) What calculation did Dev do to get £208?

[1]

(b) Is Dev's estimate too low, about right or too high?

Tick (✓) **one** box.

Too low ☐

About right ☐

Too high ☐

Give a reason for your answer.

[2]

Sample answer for question 2

(a) 5000 ÷ 24

(b) Dev's estimate is 'too low'.

He didn't take the interest rate into account and that will mean he has to pay back more than £5000.

Commentary on the answer

Both answers are correct here, with correct working shown in (a) and a correct explanation in (b).

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Question 3

An athlete won gold medals in the 100m and 200m races.

- His time for the 100m race was 9.63 seconds.
- His time for the 200m race was 19.32 seconds.

Was his average speed in the 100m race greater than or less than his average speed in the 200m race?

Tick (✓) **one** box.

His average speed in the 100m race was greater than in the 200m race.	☐
His average speed in the 100m race was less than in the 200m race.	☐

Show your reasoning. **[3]**

Sample answer for question 3

His average speed in the 100m race was greater than in the 200m race.

100m in 9.63 seconds means 200m in $9.63 \times 2 = 19.26$ seconds.

The athlete ran the 200m in 19.32 seconds which is more, so he was running faster in the 100m.

Commentary on the answer

This answer has correctly doubled up the time for the 100m and compared it to the 200m time then come to a correct conclusion regarding which race was run at the faster speed.

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Question 4

Here is a statement about the amount of time spent teaching maths in secondary schools in England:

'On average, secondary schools in England spend only 116 hours per year teaching maths.
International studies show this is far less time than other countries.
Just one extra lesson each week would put England closer to countries like Australia or Singapore who teach 143 and 138 hours of maths per year respectively.'

(a) Calculate an estimate of the number of extra maths teachers needed to increase average maths teaching time for years 7 to 11 in England from 116 hours per year up to the time taken in Australia or Singapore.

Use these assumptions:

- there are about 500 000 school students in each year group in England
- a typical secondary school mathematics teacher teaches between 20 and 25 hours a week
- students are at school for 190 days a year.

Show your working. **[6]**

(b) State clearly any additional assumption(s) you made. **[1]**

Sample answer for question 4

(a) 5 year groups with 500 000 school students in each year group

so total number of school students = 500 000 × 5 = 2 500 000

Number of classes = 2 500 000 ÷ 25 = 100 000 classes

Each class get 116 hours a year

Now 100 000 × 116 = 11 600 000 hours a year

Target 100 000 × 140 = 14 000 000 hours a year

Extra hours = 14 000 000 – 11 600 000 = 2 400 000 hours a year

190 days = 38 weeks

Teacher teaches 20 × 38 = 760 hours a year

Extra number of teachers = 2 400 000 ÷ 760 = 3158

So about 3000 extra teachers needed.

(b) Assumptions

- a teacher teaches 20 hours a week
- class size = 25
- target hours = 140 per year for each class

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Commentary on the answer

(a) The answer has been worked logically, first finding how many classes there are in total, then looking at how many hours per year would be needed if a class has 140 hours a year compared to 116 hours per year. The difference is worked out to suggest an extra 2 400 000 hours a year are needed. The number of extra teachers required is then calculated if each teacher teaches for 20 hours a week. The final answer is rounded appropriately to the nearest thousand since this is a rough estimate.

(b) There are three clearly stated assumptions of a teacher teaching 20 hours a week, class size being 25 and the target hours being 140 per year for each mathematics class. The only one required is the one about class size as the others are given in the question but there is no harm in listing them here.

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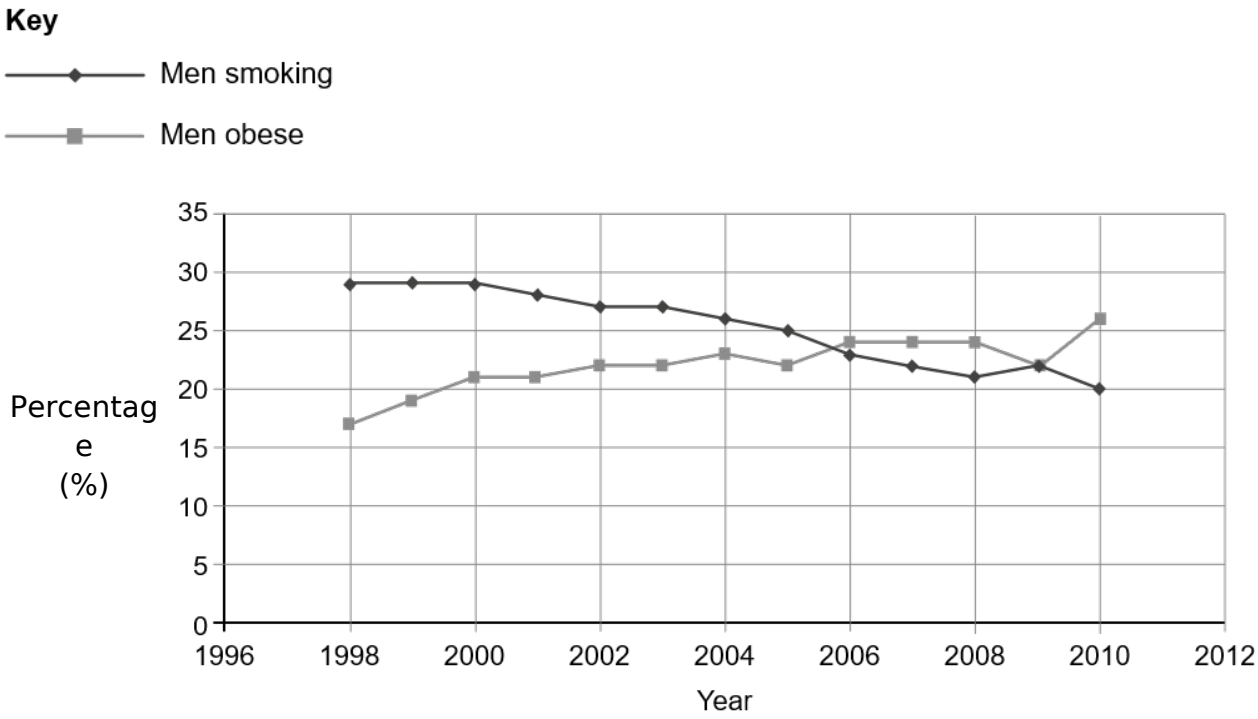
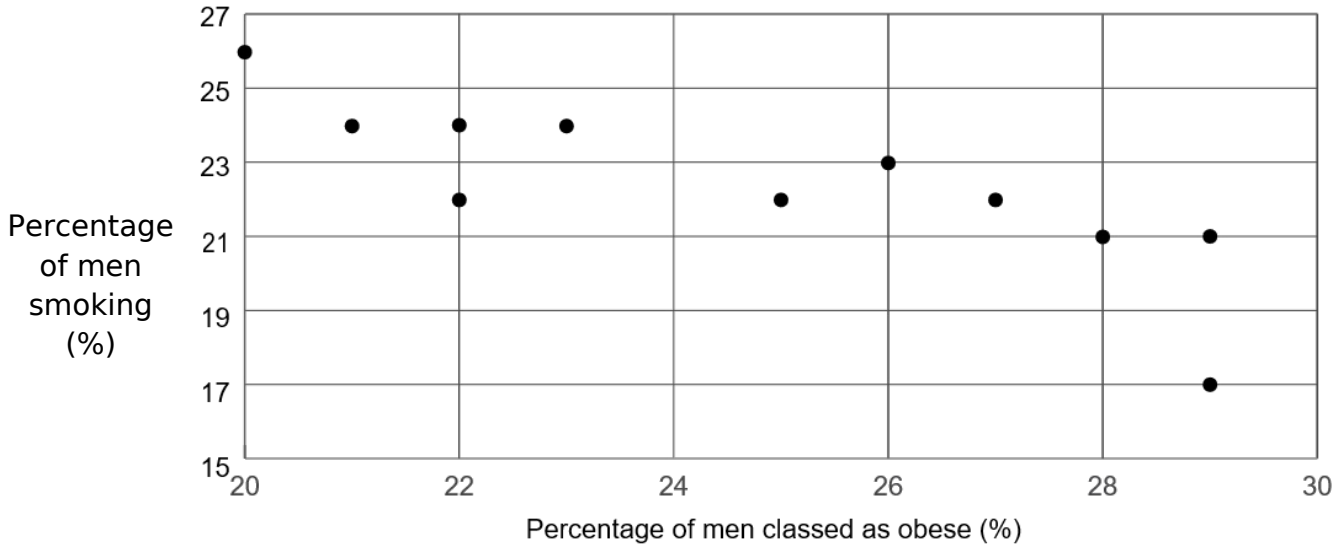
Question 5

The graphs show data about smoking and obesity for men in England from 1998 to 2010.





Make **three** comments about whether the statement below is correct or **not** correct.

‘These graphs show that giving up smoking causes obesity.’

[3]

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Sample answer for question 5

It looks like there is negative correlation – as obesity goes up then smoking seems to go down.

However, there isn't any evidence that giving up smoking caused obesity as there might be another factor like people who stop smoking sometimes give up because they have bad health and this also means they don't exercise much.

This is only about men so you can't say anything about women.

Commentary on the answer

This answer correctly identifies that there is negative correlation between obesity and smoking. It recognises that correlation does not imply causation and considers an alternative explanation for causation. There is also a relevant and true comment on the data only being for men.

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Question 6

Here are two statements about the same news story.

Statement A: 70% of parents were fined for taking their children out of school for a holiday in term time.

Statement B: The number of parents fined for taking their children out of school for a holiday in term time rose by 70% from the previous year.

(a) Use suitable numbers to show clearly what each of these statements means.

[4]

(b) Explain whether both statements mean the same as each other.

[1]

Sample answer for question 6

(a) Statement A: 7 out of 10 of all parents who take their children for a holiday in term time were fined.
Statement B: Say last year 100 parents got fined, this year 170 parents got fined.

(b) They are not the same thing because the first statement says most parents got fined but the second one, we don't know the percentage that got fined - it might only be a small percentage. The second one is about the percentage increase from the year before.

Total = £33.65

Commentary on the answer

(a) The two statements are explained correctly using suitable numbers.

(b) A comparison has been made between the two statements, and they have shown that they are not the same.

Question 7

This question is based on article B in the **pre-release material**, 'Male to female sex ratio'.

A clean copy of the pre-release material is provided as an Insert.

The male to female sex ratio at birth is the number of males that are born for every female born.

The table shows the two countries with the highest male to female sex ratios at birth in 2013.

Country	Male to female sex ratio at birth	Population (thousands)	Births per 1000 of population
Liechtenstein	1.26	37	10.67
Azerbaijan	1.13	9590	17.17

(a) (i) Show that the total number of births in 2013 in Liechtenstein can be estimated as 395.

[1]

(ii) Show that, of these 395 births, approximately 175 are female and approximately 220 are male.

[3]

(b) A researcher is investigating whether the number of males born in some countries is distinctly different from the number of females.

Her initial model is that the long-term probability of a new baby being a male is 0.5.

(i) According to the model, what would be the **mean** number of males for 395 births?

[1]

(ii) According to the model, what would be the **standard deviation** of the number of males for 395 births?

[2]

(iii) Explain whether the figures of 175 females and 220 males provide strong evidence that the initial model is **not** correct for Liechtenstein.

[4]

(iv) In 2013 in Azerbaijan 77 305 females and 87 355 males were born.

Show that these figures provide strong evidence that the initial model is **not** correct.

[4]

Sample answer for question 7

(a) (i) 37 × 10.67 = 394.79 which is about 395

(ii) The ratio means for every 1 female there are 1.26 males.

1 + 1.26 = 2.26

395 ÷ 2.26 = 174.77 which is about 175

So, there are about 175 females and 175 × 1.26 = 220 males

(b) (i) 395 ÷ 2 = 197.5

(ii) Standard deviation = $\frac{\sqrt{n}}{2} = \frac{\sqrt{395}}{2} = 9.94$

(iii) 197.5 + 3 × 9.94 = 227.32

197.5 – 3 × 9.94 = 167.68

So, 220 and 175 are within 3 sd of the mean so the data can be considered not that unusual. So not strong evidence that the model is incorrect.

(iv) 77 305 females and 87 355 males

mean = (77 305 + 87 355) ÷ 2 = 164 660 ÷ 2 = 82 330

standard deviation = $\frac{\sqrt{164\,660}}{2} =$ 202.9

For males the number of sd from the mean $= \frac{87\,355 - 82\,330}{202.9} = 24.8$

This is much more than 3 sd so there is strong evidence to suggest the probability is not 0.5.

Commentary on the answer

a) (i) This first calculation of 37 × 10.67 is correct.

b) (ii) The second calculation correctly works out the total numbers of males and females using the ratio of 1.26 and 395 births.

c) (i) This calculation correctly works out that if the probability is 0.5 then the expected number of males and females is 197.5.

d) (ii) The answer has used the correct formula to find the standard deviation.

e) (iii) The mean and standard deviation are used correctly to identify whether the numbers of males and females given are outliers.

f) (iv) In this part the mean is worked out correctly. As with part (ii), the working for standard deviation is correct and the last statement addresses the idea of strong evidence by finding how many standard deviations from the mean the number of males is. (It would have been just as good to consider how many standard deviations from the mean the number of females is.)

Question 8

This question is based on article A in the **pre-release material**, 'Car parking'.
A clean copy of the pre-release material is provided as an Insert.

This sign shows charges for parking in a car park.

Car park charges

Monday to Friday, 9am to 5pm
Up to 8 hours - £3

All other times
Free

£40 daily fine for parking without displaying a valid parking ticket

Drivers who pay get a ticket to display in their cars.

A warden checks the cars. If they find any cars which are **not** displaying a ticket, their drivers get a £40 fine for that day.

Many drivers use the car park every day from 9 am till 5 pm.

How often, on average, should the warden visit the car park to ensure that drivers who always pay for parking are charged less overall than drivers who never pay for parking?

Assume that:
- some drivers always pay to park and some drivers never pay to park
- all drivers who get a fine will pay it.

Justify your answer using calculations.

[3]

Sample answer for question 8

40 ÷ 3 = 13.333

So, it takes 14 days at £3 a day for it to cost more than the fine of £40.

The warden should check at least every 13 days.

Commentary on the answer

This answer correctly identifies the need to see how many times 3 goes into 40 and then answers the question that was asked.

Question 9

Athletes are tested to see if they have used performance enhancing drugs.
Drug tests are **not** completely accurate.
One drug test will show:

- a positive result for 95% of people who have taken performance enhancing drugs
- a negative result for 90% of people who have **not**.

Assume that 5% of athletes use performance enhancing drugs.

(a) Complete the two-way table to show the expected frequencies when a sample of typical athletes is tested.

You need to choose an appropriate size for the sample of athletes that is easy to work with.

	Tests positive	**Tests negative**	**Total**
Has taken drug			
Has not taken drug			
Total			

[4]

(b) What percentage of those who are tested will test positive for use of performance enhancing drugs?

[2]

(c) What proportion of those who test positive in this test have actually used performance enhancing drugs?

[2]

Sample answer for question 9

	Tests positive	Tests negative	Total
Has taken drug	475	25	500
Has not taken drug	950	8550	9500
Total	1425	8575	10000

(a)

(b) Percentage $= \frac{1425}{10\,000} \times 100 = 14.25\%$

(c) $\frac{475}{1425} = \frac{1}{3}$

Commentary on the answer

a) Starting from a total sample size of 10 000, the representative frequencies are worked out correctly.

b) The percentage is correctly worked out by taking the positive results from those athletes who use drugs and adding on those who don't (475 + 950 = 1425) and then dividing by the total of 10 000.

c) This answer correctly finds 475 as a proportion of the people who had positive results (475 + 950 = 1425).

Question 10

There are five competitors in a dancing competition.

Each dancer is judged by six judges who each give a score out of 20.

(a) Design a method to decide which dancers should take first, second and third places.

Give your method as a set of rules that can be used for other similar competitions.

[4]

(b) Explain why your design is fair.

[1]

(c) The table shows the scores for the dancers in a competition.

Dancer	Judge 1	Judge 2	Judge 3	Judge 4	Judge 5	Judge 6
Alex	19	19	15	20	20	14
Emma	12	7	4	4	7	8
Mia	10	8	11	5	5	2
Tom	16	19	20	19	17	16
Yuki	15	6	12	15	6	9

Use the method you designed in **(a)** to work out which dancers come first, second and third.

[5]

Sample answer for question 10

(a) Look at the rank order for each judge. Give 1 point for first, 2 for second, 3 for 3rd, 4 for 4th and 5 for 5th and split the points if there is a tie.

The person that gets the fewest points wins.

If two people get the same number of points, the one with more first places is better. If they have the same number of first places, then the one with more second places is better. If they have the same number of first and second places, then look at third places and so on. If they have the same number of all places (i.e. an identical set of rankings) then if there is time they should compete against each other. If not, a coin should be tossed to decide.

(b) Some judges might have been more generous than others, so looking at the rankings makes it fairer rather than just adding up all the marks.

(c) Judge 1 order: Alex, Tom, Yuki, Emma, Mia

Judge 2 order: Alex + Tom, Mia, Emma, Yuki

Judge 3 order: Tom, Alex, Yuki, Mia, Emma

Judge 4 order: Alex, Tom, Yuki, Mia, Emma

Judge 5 order: Alex, Tom, Emma, Yuki, Mia

Judge 6 order: Tom, Alex, Yuki, Emma, Mia

Alex and Tom tied for first for Judge 2, so they get 1.5 points each for that judge.

Alex = 1 + 1.5 + 2 + 1 + 1 + 2 = 8.5

Tom = 2 + 1.5 + 1 + 2 + 2 + 1 = 9.5

Yuki = 3 + 5 + 3 + 3 + 4 + 3 = 21

Mia = 5 + 3 + 4 + 4 + 5 + 5 = 26

Emma = 4 + 4 + 5 +5 + 3 + 4 = 25

First is Alex, second is Tom and third is Yuki.

Commentary on the answer

a) This answer comes to a decision based on evidence. It is detailed and includes a clear description of the method. There is also a clear explanation of what to do in the case of a tie for an individual judge and if there is a tie overall. All the data has been used in an appropriate way.

b) There is an explanation of why simple totalling of the scores is not fair.

c) The method has been applied correctly to get the correct scores and place order.

Summary of updates

Version (Date of issue)	Section	Change
Version 1.0 (03/2023)		
Version 2.0 (11/2025)		Our Sample Assessment Materials have been updated as part of our accessibility principles and to reflect our live assessment materials. These resources are based on the Sample Assessment Materials, so some questions have been restructured or re-worded and the candidate style responses have been revised accordingly.

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